Abstract

Rasogolla, one the most popular Indian dairy sweet is generally prepared from chhana obtained from cow milk. For its preparation chhana is thoroughly kneaded and made into small balls, which are subsequently boiled in clarified sugar syrup followed by slow cooling in comparatively low concentration sugar syrup. Present investigation was carried out to study the kinetics of swelling in the chhana ball during cooking for preparation of rosogolla, based on measurement of projected surface area, obtained by employing the image processing technique. Area values thus obtained in turn are converted to radius or volume as required in computation. Cooking of rosogolla involves raising the temperature in the chhana ball, causing swelling of the ball and formation of a porous structure which facilitates movement of sugar syrup into the chhana ball. During experimentation, area values at different cooking time were determined from digitally captured images at different cooking time. Variation in degree of swelling of rosogolla with cooking time, when cooked in water, and in sugar syrup of 45% strength, were tested in various solid state kinetic models, and was found that that Avrami –Erofe'ev equation fits better than other models. For ensuring the validity of the model in isothermal conditions, the core temperatures were monitored in open pan boiling, which indicated that isothermal condition was achieved beyond 15 minutes of dipping in sugar syrup. Estimated thermal diffusivity was found to be 5.0217×10^{-7} m^2/sec and indicated a dominance of an internal resistance to the heat transfer process. At lower temperature than the boiling temperature i.e., 80°C and 90 ° C, the diffusivity model did not fit well indicating the dominance of external resistance. For the period of isothermal swelling and based on the relative change in radius obtained from area measurements, Flory's theory for isothermal expansion was applied for open pan cooking. Diffusivity in cooking in water was found to be 2.4×10^{-5} m^2/sec, whereas, diffusivity in cooking in sugar syrup was found to be 1.4×10^{-5} m^2/sec.

As the sugar concentration and chhana ball composition are likely to influence the diffusion of sugar syrup, experiments were carried out to study the effects of maida percentage and strength of sugar syrup in the range of 0 - 55% on the degree of swelling of rosogolla. The response surface analysis of expansion ratio after 30 min of cooling at 3x3 experimental condition was used to develop a response equation, representing expansion ratio as functions of maida percentage and sugar syrup concentration to be used for obtaining optimum cooking condition. The variation in textural properties and swelling characteristics of rosogolla with microwave cooking, and cooked in jiggery syrup are also presented.

Keywords: *expansion ratio, image processing, response surface analysis, thermal diffusivity.*